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REPORT
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DEPARTMENT OF ENERGY HIGH-PERFORMANCE COMPUTING ACT OF 1990

JULY 19 (legislative day, JULY 10), 1990.—Ordered to be printed

Mr. JOHNSTON, from the Committee on Energy and Natural Resources, submitted the following

REPORT

[To accompany S. 1976]

The Committee on Energy and Natural Resources, to which was referred the bill (S. 1976) to provide for continued United States leadership in high-performance computing, having considered the same, reports favorably thereon with an amendment and recommends that the bill, as amended, do pass.

The amendment is as follows:

Strike out all after the enacting clause and insert in lieu thereof the following:

SEC. 1. SHORT TITLE.

This Act may be referred to as the "Department of Energy High-Performance Computing Act of 1990".

SEC. 2. FINDINGS.

The Congress finds that—

(a) over the last twenty years high-performance computing has transformed America's research laboratories, industries and offices, and has become indispensable to our way of life;

(b) national security, economic competitiveness, productivity and the quality of life are increasingly dependent on high-performance computing;

(c) the United States currently leads the world in the development and use of high-performance computing, but that lead is increasingly being challenged;

(d) the Federal Government must provide leadership in the research, development and application of high-performance computing technology through collaboration with industry, educational institutions, government laboratories and others; and

(e) for high-performance computing to have its greatest impact, the Federal Government must coordinate and make better use of existing Federal high-performance computing resources.

SEC. 3. PURPOSES.

The purposes of this Act are—

S313-36

(a) to authorize and direct the Secretary of Energy to establish a High-Performance Computing Program consisting of—

(1) a National Research and Educational Network; and

(2) Collaborative Consortia to undertake basic research and development of high-performance computing hardware and software, and to engage in research directed at the solutions to scientific and engineering problems which require the application of high-performance computing resources; and

(b) to establish a Federal Interagency High-Performance Computing Task Force.

SEC. 4. DEFINITIONS.

For the purposes of this Act the term—

(a) "Secretary" means the Secretary of Energy;

(b) "Department" means the Department of Energy;

(c) "Federal laboratory" means any laboratory that is owned by the Federal Government, whether it is operated by the Government or by a contractor;

(d) "national laboratory" means any Federal laboratory that is owned by the Department of Energy;

(e) "software creation" means any innovation or preparation of new computer software of whatever kind or description whether patentable or unpatentable, and whether copyrightable or noncopyrightable; and

(f) "educational institution" means a degree granting institution of at least a Baccalaureate level.

SEC. 5. DEPARTMENT OF ENERGY HIGH-PERFORMANCE COMPUTING PROGRAM.

(a) The Secretary, acting in accordance with the authority provided by the Federal Non-Nuclear Research and Development Act of 1974 (42 U.S.C. 5901 et. seq.) and subject to available appropriations, shall establish a High-Performance Computing Program ("HPC Program").

(b) Within one year after the date of the enactment of this Act, the Secretary shall establish a management plan to carry out HPC Program activities. The plan shall—

(1) be developed in conjunction with the Federal Government's overall efforts to promote high-performance computing;

(2) summarize all ongoing high-performance computing activities and resources at the Department of Energy that are not classified or otherwise restricted;

(3) describe the levels of funding for each aspect of high-performance computing that are not classified or otherwise restricted;

(4) establish long range goals and priorities for research, development and application of high-performance computing at the department, and devise a strategy for achieving them; and

(5) ensure that technology developed pursuant to the HPC Program is transferred to the private sector in accordance with applicable law.

SEC. 6. DEPARTMENT OF ENERGY HIGH-PERFORMANCE COMPUTING PROGRAM ACTIVITIES.

(a) The Secretary shall create a high-performance computer network to be known as the National Research and Education Network ("NREN"). The NREN shall—

(1) have a multi-gigabit-per-second data transmission capacity;

(2) enable government, industry, educational institutions and others to link together, as may be appropriate;

(3) be developed with the advice of potential users;

(4) have mechanisms that allow users to be charged appropriately for the use of the NREN;

(5) be subject to such terms, conditions, charges and limitations as the Secretary deems reasonable and appropriate;

(6) be operational by not later than the end of 1996; and

(7) be eliminated or sold to the private sector, in accordance with applicable law, when the networking needs provided by the NREN can be satisfied by other means.

(b) The Secretary shall promote education and research in high-performance computational science and related fields that require the application of high-performance computing resources by making the Department's high performance computing resources more available to undergraduate, graduate students, post-doctoral fellows and faculty from the Nation's educational institutions.

(c) The Secretary shall establish at least two Collaborative Consortia, and as many more as the Secretary determines are needed to carry out the purposes of this Act, by soliciting and selecting proposals.

(1) Each Collaborative Consortium shall—

(A) undertake basic research and development of high-performance computing hardware and associated software technology;

(B) undertake research and development of advanced prototype networks;

(C) conduct research directed at scientific and technical problems whose solutions require the application of high performance computing resources;

(D) promote the testing and uses of new types of high-performance-computing and related software and equipment;

(E) serve as a vehicle for computing vendors to test new ideas and technology in a sophisticated computing environment; and

(F) disseminate information to Federal agencies, the private sector, educational institutions and other potential users on the availability of high-performance computing facilities.

(2) Each Collaborative Consortium shall be comprised of a lead institution, which has responsibility for the direction and performance of the consortium, and participants from industry, Federal laboratories or agencies, educational institutions, and others, as may be appropriate.

(3) Each lead institution shall be a national laboratory which has the experience in research on problems that require the application of high-performance computing resources.

(4) Industrial participants in each consortium shall not be reimbursed for costs associated with their own involvement, though the consortium may fund research and development associated with prototype computing technology.

(d) The provisions of the National Cooperative Research Act of 1984 (15 U.S.C. 4301–4305) shall apply to research activities taken pursuant to this section.

(e) Each Collaborative Consortium may be established by a Cooperative Research and Development Agreement as provided in 15 U.S.C. 3710a, the National Competitiveness Technology Transfer Act of 1989.

(f) The Secretary shall report yearly to Congress regarding the HPC Program.

SEC. 7. FEDERAL INTERAGENCY HIGH-PERFORMANCE COMPUTING TASK FORCE.

(a) There is hereby established a Federal Interagency High-Performance Computing Task Force ("Task Force").

(b) The purposes of the Task Force are—

(1) to develop a government-wide high-performance computing strategy;

(2) to bring about the maximum efficient use of available Federal high-performance computing resources by Federal agencies; and

(3) to coordinate Federal agencies' policies and activities with respect to this section.

(c) The Task Force shall be composed of the Secretary of Energy, the Secretary of Commerce, the Secretary of Defense, the Administrator of the National Aeronautics and Space Administration, the Director of the National Science Foundation, and the heads of other Federal agencies that the Chairman of the Task Force may find appropriate.

(d) The Task Force shall be chaired by the Secretary and shall report to the Director of the Office of Science and Technology Policy.

(e) The Task Force shall develop a comprehensive, government-wide high-performance computing strategy that—

(1) establishes how the high-performance computing activities of Federal agencies and departments should be coordinated to carry out the strategy;

(2) establishes the goals and priorities for Federal high-performance computing;

(3) identifies the role of each Federal agency and department in implementing the strategy;

(4) recommends the level of Federal funding needed to carry out the strategy for each agency;

(5) determines which Federal high-performance computing facilities are under-utilized and why they are under-utilized, and makes recommendations to such agencies for appropriate actions;

(6) identifies agency rules, regulations, policies and practices which unduly limit the maximum efficient utilization of Federal high performance computing and network facilities, and makes recommendations to such agencies for appropriate changes;

(7) determines who outside of the Federal Government should have access to Federal high-performance computing facilities, if anyone, and the appropriate terms and conditions for such access;

(8) identifies hardware and software needed for the maximum efficient utilization of existing facilities; and

(9) disseminates information to Federal agencies, corporations, educational institutions and others, as may be appropriate, on the availability of Federal high-performance computing facilities, and the means by which access can be obtained.

(f) The Chairman of the Task Force shall establish a private sector advisory panel of persons eminent in the field of high-performance computing from the educational establishment, corporations, the private sector and from elsewhere as the Chairman finds appropriate, which shall advise the Task Force.

(g) The Task Force shall issue an annual report which shall review progress made in carrying out the provisions of this section, including activities taken by Federal agencies, describe plans for carrying out the requirements of this Act in the future, and make such recommendations as may be appropriate.

(h) The Task Force and the private sector advisory panel shall not be considered an advisory Committee within the meaning of 5 U.S.C. appendix 3(2), the Federal Advisory Committee Act.

SEC. 8. GOVERNMENT AND PRIVATE SECTOR COOPERATION.

In accordance with applicable law, the Secretary may cooperate with, solicit help from, provide funds to, or enter into contracts with private contractors, industry, government, universities, or any other person or entity the Secretary deems necessary in carrying out the provisions of this Act to the extent appropriated funds are available.

SEC. 9. OWNERSHIP OF INVENTIONS AND CREATIONS.

(a) Except as otherwise provided by law, title to any invention or software creation shall vest in the United States and shall be governed by the provisions of 42 U.S.C. 5908, the Federal Non-Nuclear Research and Development Act of 1974.

(b) No trade secrets or commercial or financial information that is privileged or confidential, under the meaning of 5 U.S.C. 552(b)(4), which is obtained from a non-Federal party participating in research or other activities under this Act shall be disclosed.

(c) The Secretary, for a period of up to five years after the development of information that results from research and development activities conducted under this Act and that would be a trade secret or commercial or financial information that is privileged or confidential, under the meaning of 5 U.S.C. 552(b)(4), if the information had been obtained from a non-Federal party, may provide appropriate protection against the dissemination of such information, including exemption from subchapter II of chapter 5 of title 5, United States Code.

SEC. 10. AUTHORIZATION.

In addition to existing authorizations that may be used to carry out this Act, there is authorized to be appropriated for the purposes of this Act $65,000,000 for fiscal year 1991, $100,000,000 for fiscal year 1992, $135,000,000 for fiscal year 1993, $170,000,000 for fiscal year 1994, and $205,000,000 for fiscal year 1995.

PURPOSE OF THE MEASURE

The purpose of S. 1976, as reported by the Committee, is to help the United States maintain preeminence in high-performance computing and to make supercomputing power available to larger segments of the United States.

To accomplish these objectives, the bill would require the Secretary of Energy to establish a program to carry out basic research and development in high-performance computing through collaborative research and development consortia. The Secretary would also be required to establish a National Research and Education Network ("NREN") to make the Nation's data and computing resources available to more segments of society. The bill also establishes a high-performance computing task force that, under the direction of the Secretary of Energy, would design and implement a

national high-performance computing strategy to coordinate the Federal Government's overall efforts in high-performance computing.

BACKGROUND AND NEED

Background

High-performance computing, a definition

A common definition of a supercomputer is simply "the most powerful computer available at any given time." However, the definition of "power" is inexact and depends on many factors, including processor speed, memory size, user skill, the type of job being performed and the type of software used.

Today, supercomputers cost anywhere from $1 million to $30 million and have 1,000 to 100,000 times more power than a typical personal computer. These supercomputers make billions of mathematical calculations per second, which is 50 to 100 times faster than the supercomputers available ten years ago.

The more general term, "high-performance computing," refers to the whole field of advanced computing technologies. These technologies include all types of supercomputers: the traditional types, such as parallel or vector processors, and the experimental types, such as large scale parallel processors, neural nets and optoelectronics. These technologies also include components of supercomputers that have great impact on the power of the computer: memory, storage devices, input/output devices and software. Computer networks are often linked under the category of high-performance computing because it is through networks that supercomputers are accessed. Furthermore, the networks themselves require sophisticated computing technology.

No one really knows what the high-performance computers of tomorrow will look like. The two most common types of high-performance computer hardware in use today are parallel processors and vector processors. Parallel processors use several very sophisticated and powerful processors to analyze different pieces of a problem at the same time. Today's large high-performance computers, such as those offered by Cray or IBM, have anywhere from two to eight processors. However, this assumes that a problem may be broken into large independent pieces. Vector processing produces a series of similar calculations in an assembly line fashion, which does not require that the problem be broken down into separate pieces.

Other types of specialized systems have appeared that are largely experimental. They use fundamentally different types of hardware architecture to obtain gains in computational power. For example, some try to gain increases in computing speed by hooking together hundreds or even thousands of simpler and slower processors. Many experts think that any large increases in computational power must grow out of experimental systems such as these.

The personal computers of tomorrow will rival the high-performance computers of today. Since the dawn of computing technology, computer performance has improved one million times. Improvements in computer design, chips and software allow today's person-

al computers to approach the power of the supercomputers used in the 1970s. The rapidly evolving nature of computing technology will permit the personal computers of the near future to approach the power of today's supercomputers.

Historical development of high-performance computing

The United States invented high-performance computing and continues to lead the world in the development of high-performance computing. The biggest single factor accounting for the development of high-performance computing has been large computational demands required by defense research, particularly in the area of nuclear weapons design.

Historically, the Department of Energy and its predecessor agencies played the lead role in the development of high-performance computing, particularly the supercomputer. Supercomputing originated with the "Los Alamos problem", the design of the first atomic bomb. In 1945, Los Alamos researchers used the first large-scale electronic computer, the ENIAC, to help solve the Los Alamos problem. Subsequent collaborations with supercomputer vendors, such as IBM, Univac (now Unisys), Control Data and Cray Resarch, have continued to this day, enabling the United States to become the leader in computational science.

In fact, Cray Research would not exist without the Los Alamos National Laboratory of the Department of Energy. In 1976 Cray offered its first supercomputer to the Los Alamos laboratory without software or an operating system if the laboratory would develop the technologies needed to operate the machine. The Department of Energy and the Los Alamos laboratory were crucial in getting the first Cray supercomputer to work. Today, Cray is the biggest manufacturer of supercomputers in the world, and the Los Alamos National Laboratory is the most powerful scientific computing center in the world, serving more than 8,000 researchers throughout the nation via a computer network.

Much of the Department's research, such as nuclear weapons design or research in high-energy physics, requires the most powerful computers available. In order to carry out the research, DOE has often accelerated the development of high-performance computers by undertaking cooperative activities involving its national laboratories and computer manufacturers, universities and other Federal agencies. The Department has shaped high-performance computing by acquiring early market and production-model computing systems for its research programs.

The Department's laboratories have become the world's most demanding, sophisticated and experienced users of supercomputers. Manufacturers of high-performance computers routinely send new prototype computers to the national laboratories for testing. The laboratories help the manufacturer identify problems, find solutions for them and write the unique software packages supercomputers require.

Today, the Department of Energy remains the biggest user of supercomputers. The Department has 33 unclassified supercomputers. The Department of Defense has 20 unclassified supercomputers. These two agencies account for three-fourths of the federal government's unclassified supercomputers.

Need

Benefits of supercomputers

Many scientific endeavors would not be possible without the use of supercomputers. For example, the data we collect from outer space can only be understood and visualized by a supercomputer. The superconducting supercollider will require supercomputers to understand the data it produces. Weather forecasting becomes more accurate the more powerful the supercomputer. The United Kingdom more accurately predicts the weather than the United States because of supercomputers. The human genome project is possible only because of high-performance computers.

It has only been recently that supercomputers have been able to graphially visualize the outcome of experiments. The ability to see the results visually in graphic form is a major step forward in scientific analysis. Without the ability to graphically visualize the results, the researcher must analyze hundreds of pages of computer printouts, a painstakingly slow process.

Most of the data this country generates from its scientific endeavors goes unused. Researchers simply do not have the computing resources to analyze all of the data that exists. For example, the data used to discover the ozone hole had existed for ten years. A researcher looking through that data while working on an unrelated problem inadvertently discovered the ozone hole.

According to Dr. William Wulf, the former Assistant Director of the National Science Foundation's Directorate for Computer and Information Science and Engineering, supercomputing and high-speed networking can increase the productivity of many American researchers by up to 200 percent. Such an increase in productivity would increase the benefits from the $70 billion a year the Federal Government spends on research and development.

Important policy questions depend on high-performance computing. Better models of global climate change would lead to better policies to address global warming. In fact, today's supercomputers are inadequate for some global studies that have been designed. The studies are waiting for sufficiently powerful supercomputers. The outcome of these studies could lead to important policy decisions with substantial implications for the world.

American industry has discovered the benefits of high-performance computers. When Airbus, a European consortium, started using supercomputers to help design more efficient airplanes, Boeing and McDonald Douglass was forced to follow. Boeing then used a supercomputer to design a 30-percent more efficient airplane. This savings offset the cost of the supercomputer and helped Boeing to remain competitive.

ARCO used a Cray supercomputer to increase production of its Prudhoe Bay oil field resulting in an additional $2 billion in profits. ALCOA used supercomputing modeling to reduce the amount of aluminum needed in its aluminum cans by 25 percent. This reduction saved billions of dollars from reduced materials, production, and transportation costs.

The most extensive user of supercomputers has been for defense applications. The National Security Agency requires the fastest supercomputers available for signal processing and breaking codes.

The Strategic Defense Initiative relies heavily on supercomputers. The nuclear weapons program within the Department of Energy remains the single biggest consumer of supercomputers.

Benefits of computer networks

Research users were the first to link computers into networks for the purpose of sharing information and broadening remote access to computing resources. The Defense Advanced Research Project Agency created ARPANET in the 1960s to advance networking and data communications and to develop a robust communications network that would support the data-rich conversations of computer scientists. Other federal agencies soon followed with their own specialized networks for their research communities. Academic and industry users not served by the agency sponsored networks developed their own networks.

Today, there are thousands of computer networks in the United States. These networks range from temporary linkages between desk top computers over common carriers to institution-wide area networks, to regional and national networks. Some of the services are amateur and poorly maintained, while others are mature information organizations with well-developed services.

Recently, some agencies have pooled funds to support a shared national backbone called the Internet to connect existing networks. The need for connecting the users of the networks has been the primary reason for the Internet. Just as telephones would be of little use if only a few people had them, a network's usefulness comes from the ability of each network to reach the desks, labs, and homes of its users. Networks expand access to computing resources, data, and instruments and allow users to communicate with each other. The payoff comes from connecting people, information, and resources.

Technologies developed through research networks have enhanced the productivity of all economic sectors. Today's federally supported networks resulted in frontier-breaking network research leading to advances in data-networking technologies. Packet-switching technology developed for the ARPANET has resulted in multibillion dollar data handling for business and financial transactions.

This legislation would create a National Research and Education Network (NREN) with the capability of transmitting billions of bits of data per second. Such a network will bring substantial benefits. Today's networks transmit data at the rate of 1.5 million bits per second, more than a thousand times slower than the proposed NREN. The NSF announced this year it was upgrading its NSFNET to 45 million bits per second. Yet, this rate is slow in computer speed. The supercomputers and data bases connected to NSFNET is growing at the rate of 20 to 30 percent per month, the new capacity will soon be saturated.

High data rates are needed to carry out even the most basic scientific studies. Today, if a scientist wants to study global warming, the data must be physically carried to a supercomputer, processed and then physically returned. A high-speed network would allow that same scientist to transmit the data in seconds, process the data and graphically see the results as the computer is carrying out the study. The scientist could easily change variables in the

data and rerun the program as he gains feedback and understanding from the computer.

Other countries have also recognized the benefits of high-speed networks. Japan's Nippon Telegraph and Telephone Corporation has announced that it intends to invest $126 billion to install a national fiber optic network which will reach every home, office, and factory in Japan and be capable of transmitting data at the rate of hundreds of millions of bits per second. The Europeans have launched their own initiative to build a high-speed network. Other countries have launched national initiatives. The United States has yet to follow.

Government support for applied research can decrease risk, create markets for network technologies and services, trascend economic and regulatory barriers, and accelerate early technology development and deployment. A Federal commitment to build a national research and education network would accelerate its creation by 5 to 10 years. This would not only bolster U.S. science and education, but would fuel industry R&D and support the market competitiveness of the U.S. network and information services industry.

United States leadership in high-performance computing is being challenged

While the United States continues to lead the world in the development of high-performance computing, that lead is being challenged. Some estimate that the Japanese will dominate the supercomputer market in the early 1990s. Yet, the Japanese did not enter the field of high-performance computing until 1983. Today, outside of the United States, Japan is the single biggest market for and supplier of supercomputers. American supercomputers account for less than one-fifth of all supercomputers sold in Japan.

Japan's three supercomputer manufacturers, NEC, Hitachi and Fujitsu, have made rapid advances in high performance computing technology. In 1989, NEC announced the development of a supercomputer with processor speeds up to eight times faster than Cray Research's fastest machine at the time of NEC's announcement.

European countries are also catching up with the United States. West Germany, France, England, Denmark, Spain, Norway, the Netherlands, Italy, Finland, Switzerland and Belgium all have supercomputers. The United States remains the biggest consumer of supercomputer, but only because the Federal Government purchases 65 percent of all supercomputer installed in the United States. In Japan, industry consumes the biggest share of supercomputers.

Other countries have launched national efforts to undertake research and development in high-performance computing and promote its use. The United Kingdom began implementing a national high performance computing plan in 1985. The European Community just completed Phase I of its "European Strategic Programme for Research in Information Technology (Esprit)". Phase one, which lasted for 5 years, received $3.88 billion in funding and concentrated on research and development in information related technologies. Phase II calls for the commercialization of Phase I technologies. An estmated $4.14 billion will be provided for Phase II.

The U.S. Government currently spends $500 million a year directly on high-performance computing. The spending occurs through uncoordinated efforts of individual agencies working on individual projects. While this benefits select companies and specific technologies, the Government's overall efforts have been lacking and American industry cannot meet the challenge singlehandedly.

Though IBM is now trying to reenter the high-performance computing market after a 20-year hiatus, Cray Research remains the United States' only supercomputer manufacturer that can sell the most powerful supercomputers available. Other companies have been formed to develop new types of high-performance computers. For example, the Convex computer company took the approach of developing so-called "minisupercomputers" that rival the power of the Cray computer of a few years ago. These minisupercomputers enjoy remarkable success in this country and abroad because of their relatively low cost.

Other experimental designs are in the process, and some prototypes have been built. For example, the Thinking Machines Corporation developed a prototype supercomputer containing 65,536 processors. However, these experimental designs face large obstacles in becoming viable products in the marketplace. Because of the high capital costs associated with high-performance computers, it is difficult to develop new supercomputers, to build them, and to convince companies to spend anywhere from one to thirty million dollars to purchase one.

One year ago, Cray's only American competition in the general-purpose supercomputer market, Control Data Corporation, closed its subsidiary, ETA Systems. Control Data invested over $400 million in its supercomputer subsidiary. The company's investment and technology contribution have been lost, including the nation's only automated supercomputer manufacturing company.

Control Data's inability to sell its supercomputer to the government contributed to the company's failure. Cray Research has enjoyed success largely because the Department's laboratories have helped Cray improve its supercomputers and the software for them. Armed with proven supercomputers and the software to run them, Cray has had a much easier time convincing private industry to invest in their supercomputers.

Because of changes in the procurement process, federal laboratories and agencies have become reluctant to purchase new prototype computers. Faced with this new policy and Cray's established position as industry leader, companies such as Control Data have difficulty entering the supercomputer market.

This bill would provide a strong support base for the development of high performance computing activities, particularly supercomputers. The collaborative research and development consortia established by the bill will help stimulate development of supercomputers by reducing the risk of research and development to United States manufacturers.

The need for immediate action

The White House Science Council Committee on Research in Very High-Performance Computing in its November 1985 report came to the following conclusion:

> The bottom line is that any country which seeks to control its future must effectively exploit high performance computing. A country which aspires to military leadership must dominate, if not control, high performance computing. A country seeking economic strength in the information age must lead in the development and application of high performance computing in industry and research.

Dr. Allan Bromley, the President's Science Advisor and Director of the White House Office of Science and Technology Policy (OSTP), stated that high-performance computing must be "a very high priority" because "it has a catalytic effect on just about any brand of research and development" and "will, eventually, transform industry, education, and virtually every sector of our economy, bringing higher productivity and enhanced competitiveness."

In response to a 1986 request by Congress, the OSTP prepared a report on options for high-performance computing. This report has since been revised into a national high-performance computing initiative released in September 1989, entitled a "Federal High Performance Computing Program". The initiative calls for an ambitious research and development program in high-performance computing systems, advanced software and algorithms, a National Research and Education Network (NREN) and long term support for human resources. The OSTP report emphasizes the need for coordination, stable funding, broadened goals, integrated management and increased private sector involvement.

Congress' own Office of Technology Assessment released its interim report on high-performance computing in September 1989. The report calls for immediate and coordinated Federal action to bring together the high-performance computing activities of the Federal Government. The report cites the importance of high-performance computing to our economic security, national security and the scientific community.

Congress, the Executive branch, the research community and the private sector all recognize the wisdom of devoting substantially more resources to high-performance computing for its own sake and for the Federal Government to assume a leadership role in such an effort. Issues related to high performance computing have been subjected to extensive studies over the last decade. Many committees have been formed, and reports released, all calling for immediate action. The Federal Government should commit itself to a national high-performance computing initiative.

While the OSTP plan sets out a national initiative, it has yet to be implemented. In fiscal year 1990, the Federal Government spent $448 million on high-performance computing. The President's fiscal year 1991 budget request calls for the Federal Government to spend $469 million, a 5 percent increase. While a 5 percent increase does correct for inflation, it falls short of the recommendations of the President's OSTP report, which calls for a funding increase of $2 billion over current levels, spread over 5 years. Furthermore, the organization chosen by the OSTP report to coordinate the Federal Government's activities lacks sufficient authority to do so.

The OSTP report would use as the primary vehicle to implement the national initiative the Federal Coordinating Council for Science, Engineering and Technology (FCCSET). FCCSET has been instrumental in helping to formulate a national strategy and bringing awareness of the importance of this issue. FCCSET developed the initiative through informal interagency committees. The OSTP report would continue the informal nature of the FCCSET process to implement the initiative. FCCSET is ill-equipped to operate a major Federal program. FCCSET has neither the authority nor resources to effectively integrate the activities of the various Federal agencies to implement a national high-performance computing strategy.

For the initiative to move forward the Federal Government must commit itself to action and give sufficient authority, direction and resources to its agencies to carry out the initiative. The initiative needs a lead agency capable of operating the program. Congress must formally establish the roles FCCSET and the other Federal agencies will play, their responsibilities, and the national goals to be achieved. Without such direction and commitment by Congress the overall effort in high-performance computing will be unwieldy, unfunded, uncoordinated and slow.

For example, Federal leadership and funding brought together a wide base of university commitment, national laboratory and academic expertise, and industry interest and technology in creating the Internet. Each of the networks forming the Internet was created individually. The patchwork nature of the current myriad of networks has resulted in some networks of high quality, others of low speed, poor quality and limited accessibility. The patchwork nature limits the effectiveness of the Internet.

The rapidly growing demand for services provided by the Internet has already saturated the network's capabilities. Demand overburdens the informal administrative arrangements between agencies to operate the Internet. Expanded capability will require a strengthened Federal management role as well as substantial technological innovation and investment.

The vehicle being used today to operate the Internet in the Federal Research Internet Coordinating Committee (FRICC), which is a subcommittee of FCCSET. The OSTP report recommends that FRICC coordinate the creation of the NREN. FRICC is an informal committee that grew out of agencies' shared interest in coordinating related network activities and avoiding duplication of resources. While FRICC has achieved remarkable progress to date, the future of the NREN can no longer depend on an informal arrangement of agencies. None of these agencies has funding authority to create the NREN. Management of a sophisticated, heavily used network cannot be based on loose policy guidelines from FRICC. Individual agency priorities and budget fortunes should not dictate what the future of the NREN is to be. Under the status quo, continued progress in achieving a national network remains uncertain.

The OSTP report also leaves important policy issues regarding the NREN unresolved. It calls for commercialization, but fails to specify how that will take place. It does not address cost recovery or access the NREN. All networks require standards at some

common denominator. What standards should be imposed? To what extent should industry participate?

FRICC can discuss these issues, but as an informal interagency committee it lacks the authority to implement decisions. The achievements of FRICC resulted from voluntary participation by federal agencies. With the scaling up of the network, more formal mechanisms, with sufficient authority, are needed to deal with larger budgets, to more tightly coordinate further development, and to decide the important policy issues that will come up as the NREN develops. Even if FRICC has the authority to create the NREN, the future of the NREN will be uncertain. Since FRICC is an interagency committee, no one agency is solely responsible. Each agency will vie for its own individual agendas through FRICC. No one agency has the authority or responsibility to resolve the interagency conflicts and demands. The tough choices that will have to be made will more likely be deferred than resolved. A single lead agency with sole responsibility is needed to take charge of the NREN.

FRICC placed the National Science Foundation as the lead agency in deploying and operating the network. Other agencies were not considered for this role because it was assumed NSF would be the lead agency. The NSF created the backbone for the Internet. NSF also asked FRICC to prepare the NREN program plan, and FRICC is chaired by NSF. Furthermore, under the OSTP plan NSF's role as a lead agency is weakened by the need to work through FRICC.

Other agencies such as the Department of Energy were not considered. FCCSET or OSTP did not select DOE to undertake the NREN as it is not directly related to DOE's core missions. Nonetheless, DOE is well equipped to assume such a leadership role. DOE has extensive experience in creating computer networks, the resources to establish the NREN and the management structure and experience to operate the NREN. Because of these resources, DOE has no need to act through an interagency committee as FRICC.

The Committee believes that DOE management will bring accountability, stability, and freedom from interagency politics and budget uncertainty. As the NREN develops and the DOE gains feedback DOE can immediately implement a course correction. As the agency with sole responsibility DOE will decisively resolve the issues and not defer them to the FRICC process.

DOE will move much more quickly than the FRICC process. DOE, unlike the NSF, is familiar with the particular issues that confront a large agency in developing a computer network that is open to users outside of the agency. DOE has the expertise to develop uniform standards for the NREN. DOE has the technological experience to link together the vast array of existing networks. DOE has the resources and expertise to provide the decisive leadership needed to develop the NREN.

The success of a national high-performance computing initiative also depends ultimately on the management structure placed upon it, and not on the spending levels. The Committee believes that a Federal interagency high-performance computing task force can integrate the components among Federal agencies, and ensure participation from the private and academic sector. This formal alli-

ance between government, academia and industry will provide guidance in integrating the program. But, the program must be managed by a lead agency experienced in technology development and program operation. That agency is DOE. Under DOE leadership, the Federal Government should commit to a national high-performance computing initiative that will consolidate and fortify agency plans, devote substantially more resources, and catalyze a broader national involvement.

LEGISLATIVE HISTORY

Senator Johnston, with Senators McClure and Gore as cosponsors, introduced S. 1976 on November 21, 1989. The bill was referred to the Committee on Energy and Natural Resources. On March 6, 1990, the Subcommittee on Energy Research and Development held a hearing on the bill.

A similar bill, S. 1067, was introduced by Senator Gore on May 18, 1989, and referred to the Committee on Commerce, Science, and Transportation. The Subcommittee on Science, Technology, and Space held three hearings on S. 1067 on June 21, July 26, and September 15, 1989. On April 3, 1990, the Commerce, Science and Transportation Committee ordered S. 1067 favorably reported with an amendment in the nature of a substitute.

H.R. 3131, a companion bill to S. 1067, was introduced on August 8, 1989, and referred to the Committee on Science, Space, and Technology. On March 14, 1990, the Subcommittee on Science, Research and Technology held a hearing on the bill.

At a business meeting on June 27, 1990, the Senate Energy and Natural Resources Committee ordered S. 1976 favorably reported with an amendment in the nature of a substitute.

COMMITTEE RECOMMENDATIONS AND TABULATION OF VOTES

The Senate Committee on Energy and Natural Resources, in open business session on June 27, 1990, by a unanimous vote of a quorum present, recommends that the Senate pass S. 1976, if amended as described herein.

The rollcall vote on reporting the measure was 19 yeas, 0 nays, as follows:

YEAS	NAYS
Mr. Johnston	
Mr. Bumpers [1]	
Mr. Ford	
Mr. Bradley	
Mr. Bingaman [1]	
Mr. Wirth	
Mr. Conrad	
Mr. Heflin	
Mr. Rockefeller [1]	
Mr. Akaka [1]	
Mr. McClure	
Mr. Hatfield [1]	
Mr. Domenici [1]	
Mr. Wallop	
Mr. Murkowski [1]	

Mr. Nickles [1]
Mr. Burns
Mr. Garn
Mr. McConnell

[1] Indicates voted by proxy.

COMMITTEE AMENDMENTS

The Committee adopted an amendment in the nature of a substitute to S. 1976.

S. 1976 as introduced required the Secretary of Energy to develop a long-range plan for high-performance computing within the Department. The plan required the Secretary to establish a National Research and Education Network (NREN), carry out research and development of software and high-performance computing technology, and to educate and train more researchers in computer science and related fields. Specific authorization levels for each activity were provided.

The amendment authorizes the same activities but restructures the program under which the Secretary carries out those activities. Also, the specific responsibilities associated with each activity were expanded in some cases and narrowed in others.

High-performance computing program

The amendment directs the Secretary to establish a High-Performance Computing Program (the "Program") subject to available appropriations. The establishment of the Program will elevate the importance of high-performance computing within the Department from an activity used to support other Department missions, to being a mission of the Department. The Secretary will implement the Program through a management plan.

The amendment requires the Secretary to develop the management plan in conjunction with the Federal Government's overall efforts in high-performance computing. A successful high-performance computing initiative by the Federal Government requires cooperation between all Federal agencies with each agency contributing to the initiative from their respective areas of expertise.

As part of the Program, the amendment directs the Secretary to undertake three major activities. The amendment requires that the Secretary establish a National Research and Education Network (NREN); it requires the Secretary to promote education and research in high-performance computational science and related fields; and it requires the Secretary to establish collaborative research and development consortia.

National Research and Education Network (NREN)

The amendment requires the Secretary to make the NREN operational by 1996. The NREN will enable government, industry, educational institutions and others to link together as may be appropriate.

The amendment directs the Secretary to develop the NREN in close cooperation with all potential users. Potential users of the NREN include the computer and telecommunication industries, the

higher education community, researchers, librarians, Federal agencies and information service providers.

The Internet has only been possible through the cooperation of Federal agencies as coordinated by FRICC. The amendment selects the Department as the lead agency to develop the NREN. This ensures a formal mechanism with the necessary authority and resources needed to deal with the larger budgets, to more tightly coordinate further development and decide important policy issues as the NREN develops.

Management of the NREN should be stable enough to survive political and budgetary changes, but flexible enough to allow for accountability, feedback, and course correction. It should promote cost efficiency and provide incentives for commercial networks. The selection of the DOE, with its extensive resources and networking experience, as the lead entity will bring this management structure into the NREN.

In carrying out its role as the lead agency, DOE will work with other Federal agencies through the Federal Interagency High-Performance Computing Task Force established by the bill. Though DOE has sole authority and responsibility to establish the NREN, the Task Force allows the Secretary to coordinate research efforts between DOE and other agencies, such as DARPA, to gain input from the other agencies and the Task Force's private sector advisory panel. Such input will be instrumental in helping the Secretary resolve important policy issues that will confront the Secretary as the NREN develops.

The amendment addresses some, but not all of these policy issues. For example, to what extent should industry participate in the development of the NREN? The amendment requires that the NREN be eliminated or sold to the private sector when the networking needs provided by the NREN can be met by other means. The Secretary will establish the NREN in a manner that fosters competition and investment in high speed networking within the telecommunications industry. The amendment requires that user fees be charged when appropriate. However, the Secretary, through the Task Force, could decide the extent to which user fees are charged as the users of the NREN, and the extent of such use becomes apparent.

The amendment does not provide when commercialization will occur. Though the NREN will be operational by 1996, its make-up will be largely unknown. Once operational, the NREN will continue to grow in size, both in terms of the services the NREN provides and the number and kinds of users. Because of these uncertainties, the amendment gives the Secretary the flexibility to decide when and the extent to which commercialization or elimination of the NREN will occur.

The Secretary may eventually sell all of the NREN to the commercial sector, or the Secretary may only turn over part of the NREN because the commercial sector can only partially provide the services offered by the NREN. The Secretary could use a consortium of universities and private companies to build the NREN. Such a government-industry-academia partnership leads to an easy transition to full commercialization.

To deal with these unresolved issues, the amendment gives the Secretary broad authority in establishing the NREN. The amendment directs that the NREN be subject to such terms, conditions, charges and limitations as the Secretary deems reasonable and appropriate.

Collaborative research and development consortia

The amendment directs the Secretary to establish at least two collaborative research and development consortia (CRDCs) between industry, Federal laboratories or agencies, educational institutions and others as may be appropriate.

The exact number depends on the number needed to carry out the purposes of this Act, the cost of each and the amount of funding available. As the Secretary gains experience with the CRDCs, the Secretary has the flexibility to create more CRDCs and change the structure or activities of them. The CRDCs will directly support the goals of the bill by helping to shape high-performance computing technology, and by putting more useful computing power into the hands of U.S. industry, higher education and broader segments of the population.

Building on current models

DOE and its laboratories are in a position to help the U.S. maintain its leadership, strengthen the U.S. computing industry, and encourage deployment of high-performance computing in analysis, design, concurrent engineering, and manufacturing for U.S. industry. In the past, the Department accomplished this role almost entirely with the financial support of the nuclear weapons, research, development and testing program. That is no longer appropriate, nor possible, today. The Department's contributions now extend to a much broader spectrum from the human genome project to enhanced oil recovery. From these new applications the Department can continue to shape high-performance computing.

The Department of Energy's Advanced Computing Laboratory (ACL) at Los Alamos National Laboratory provides a prototype CRDC. The ACL acts as a catalyst by collaborating with industry to conduct research in three key technology areas: real-time visualization, high-speed networking and software for sophisticated scientific computer programs.

The ACL also serves as the primary interface for Los Alamos laboratory participation in several other activities: the DOE/Applied Mathematical Sciences Advanced Computing program, the NSF Science and Technology Center for Research on Parallel Computation (a consortium of Rice University, Caltech, Los Alamos, and Argone), and the Gigabit National test bed.

The need to solve a broad spectrum of applications drives the activities of the ACL. Los Alamos' ACL provides an excellent example of an existing center of excellence in high-performance computing that is positioned to participate in the development of computing technology through the High-Performance Computing Program.

CRDC structure

The amendment allows virtually all of the required activities to be carried out through the CRDC's. For example, the amendment requires the Secretary to promote education and research in high-performance computational science and related fields. The CRDC's may meet this requirement by providing opportunities to graduate students to work and study at the CRDC's through fellowships.

The CRDC's may also involve university faculty and students to address computational problems that may result in new approaches to high-performance computing hardware, software and algorithms. Such collaboration will help raise a new generation of computer scientists.

The CRDC's could help to establish the NREN required by the amendment. The CRDC's could undertake research and development of advanced prototype networks in helping to establish the NREN. Since the NREN will require sophisticated software applications, CRDC's would be an excellent resource in helping to write the software. Furthermore, both hardware and software development are specific activities the amendment requires the CRDC's to undertake.

The amendment requires that the Secretary establish each CRDC by soliciting and selecting proposals. This will establish a competitive atmosphere generating a number of proposals for the Secretary to select from.

A lead institution will lead each CRDC. The amendment specifies that each lead institution be a Department of Energy national laboratory with experience in research problems requiring the application of high-performance computing resources. The use of a DOE national laboratory as a lead institution and the requirement for experience with high-performance computing builds and expands upon the knowledge and experience of the Department's national laboratories.

While the lead institution has responsibility for the direction and performance of the consortium, the other participants from industry, universities, and the Federal sector may carry out CRDC activities. Thus, not all of the many activities the CRDC will perform will necessarily take place at the geographic location of the lead institution. Most likely, the participants will be spread out through the country. Each of the participants will have their own specific task assigned to them. Geographically distributed participants allow the CRDC's to develop advanced prototype networks, promote technology transfer, and involve more individuals from diverse backgrounds.

Just as with the activities of the ACL, the need to solve a broad spectrum of applications will determine the activities of each CRDC. The amendment requires that each CRDC conduct research directed at scientific and technical problems whose solutions require the application of high-performance computing resources. In the same way that the DOE laboratories have provided the "pull" for high-performance computing technology from the computing industry in the past because of the intense computational demands of the nuclear research program, the CRDC's will challenge high-per-

formance computing vendors to continue pushing the state of the art through other computation-intensive scientific problems.

CRDC activities

The amendment requires that the CRDC's are to undertake basic research and development of high-performance computing hardware and associated software technology. S. 1976 as introduced illustrated the kinds of high-performance computing hardware systems envisioned: processors, input/output devices, parallel computer architectures, optoelectronics and mass storage technology. Also illustrated were kinds of computer technology associated with high-performance computing systems, such as advanced semiconductor computer chip designs, new materials for integrated circuits, improved integrated circuit fabrication techniques, photonics, and superconducting computer components. Types of software and algorithms were also mentioned.

The amendment intentionally leaves silent the types of technology to be supported. The list set out in S. 1976 as introduced was illustrative only. In setting out such a list many other kinds of computing technology were left out: neural nets, distributed data storage systems, advanced ceramic materials for electronic packaging and various kinds of software technology. The amendment remains silent on the kinds of technology supported in order to avoid leaving out any kind of computing technology that exists today or that has yet to be invented.

By remaining silent, no one technology gains more importance over any other. This gives the Secretary the needed flexibility to adapt to the rapidly changing nature of computing technology. The Administration supports the goals and purposes of a high-performance computing initiative, but the Administration felt S. 1976 locked in funding levels for specific kinds of technology denying it the flexibility it needs to meet the rapidly changing environment of high-performance computing. The Committee believes that the reported bill provides the needed flexibility.

The amendment requires that the CRDC's serve as vehicles for testing new technology in a sophisticated computing environment. Los Alamos' ACL illustrates how a CRDC can serve as such a vehicle. The ACL has helped Thinking Machines, Inc., develop a second generation Connection Machine. Scientific problems requiring intense computational resources test the Connection Machine's performance.

This collaboration between the laboratories and industry will help computing vendors understand what products will be needed next, and help industrial users to learn what high-performance computers can do for them.

The amendment does not subsidize industry. The amendment prohibits industrial participants from being reimbursed for costs associated with their own involvement. The Secretary has flexibility in establishing to what extent industry should share in the cost.

For example, a company may detail one or more employees to a CRDC in order to help the CRDC study that company's latest product. The company would not be reimbursed for the expenses associated with that employee. However, the company may sell the product to the consortium. Some companies may sell their product at

cost or even offer the use of the machinery at no cost to a CRDC. Companies stand to gain substantial benefits from improvement the CRDC's may make to the product. A CRDC will improve the company's product giving that company an incentive to allow a CRDC to use it at little or no cost.

However, a CRDC may wish to fund a particular type of prototype computing technology, which any one company cannot undertake by itself. The amendment authorizes the CRDC's to fund research and development of prototype computing technology. The CRDC's may pay full cost, or may only pay partial cost. The competitive forces of the selection process may well establish the allocation of costs between the Secretary and the CRDC participants under the general principle that industry will pay its own way.

The technology developed through the CRDC's will be rapidly disseminated to vendors as well as users. The collaboration between industry, universities and the Federal Government will accomplish this goal. The Secretary may establish each CRDC as a Cooperative Research and Development Agreement (CRDA) as provided for in the National Competitiveness Technology Transfer Act of 1989 (15 U.S.C. 3710a). The reference to this Act makes it clear that the CRDC's may be established as a CRDA, and not that they have to be. This gives the Secretary the flexibility to choose the technology transfer mechanisms most appropriate for each of the CRDC's.

The Secretary may devise new types of technology transfer mechanisms, such as an industrial user program. For example, high-performance capabilities might be made available through high-speed networks to industries who have been reluctant to make use of high-performance computers. Demonstration programs of the value of high-performance computing to businesses, schools and universities might also be utilized.

To belay the fears of companies of potential antitrust problems, the amendment expressly affords the protection offered by the National Cooperative Research Act of 1984 (15 U.S.C. 4301-4305) to research activities carried out under the amendment.

Federal Interagency High-Performance Computing Task Force

The amendment establishes in law a Federal Interagency High-Performance Computing Task Force (the "Task Force") as the appropriate vehicle to carry out a national high-performance computing initiative and gives it the appropriate authority to do so. The same agencies that are involved in the high-performance computing effort through FCCSET are on the Task Force. Many of the recommendations made by the OSTP report will be adopted by the Task Force. Enacting legislation establishing this Task Force offers many advantages.

The amendment mandates that the Task Force develop a national strategy, and then to coordinate Federal agencies' policies and activities in implementing that strategy. The OSTP's recommended national program merely recommends a course of action. Agency participation in fashioning a national initiative under the OSTP initiative would be voluntary. For the initiative to move forward a high degree of coordination between the agencies is necessary.

FCCSET's informal agency arrangements cannot achieve that level of coordination.

All those interested in the initiative will have input into the Task Force. Non-Federal parties have not been adequately represented by FCCSET. The amendment establishes a private sector advisory panel to represent all non-Federal parties interested in the initiative.

The high-performance computing initiative will be the Task Force's only responsibility. FCCSET has broad responsibility to coordinate scientific activities of federal agencies in general. An entity with its only charge being the creation and implementation of a national high-performance computing initiative will be free from other duties and responsibilities which might otherwise slow down the process.

The Secretary of Energy is to chair the Task Force. Because of the significant responsibilities the Secretary plays in the national high-performance computing initiative, the amendment requires that the Task Force be chaired by the Secretary. For example, in developing the NREN, other Federal agencies cooperation with the Secretary of Energy is essential in creating the network. The collaborative research and development consortia established by the amendment also involve extensive cooperation with other agencies in carrying out research and other activities.

Finally, there will be significant oversight by Congress in the implementation of the initiative. With the Secretary of Energy chairing the Task Force, there will be one spokesperson for the initiative. It would be difficult under FCCSET for Congress to assert its oversight authority.

Ownership of Inventions and Creations

The amendment requires that title to any invention or software creation, a defined term, to vest in the United States and be governed by the provisions of 42 U.S.C. 5908, unless otherwise provided by law. The amendment does not change or effect the myriad of intellectual property laws that exist today. Rather, the provision addresses a gap in the law.

The only protection afforded to inventors of software is a copyright. However, under current law the government may not obtain protection through the copyright laws. Without an express provision dealing with title, who owned software developed under the amendment may not be clear. The amendment closes this gap by investing title to "software creations" in the government. The amendment then grants the generic authority provided under 42 U.S.C. 5908 to the Secretary in dealing with intellectual property rights. However, to the extent another law would specifically govern title or the allocation of property rights to inventions, that other law would apply.

For example, the CRDC's may well be established as a Cooperative Research and Development Agreement under the National Competitiveness Technology Transfer Act of 1989 (15 U.S.C. 3710a), which has its own patent protection provision. To the extent that those provisions, or any other law, may be applied, they should be.

The amendment also prohibits the disclosure of trade secrets, or commercial or financial information. Without this protection, non-Federal parties are reluctant to participate in research activities with the Federal Government. The amendment prohibits disclosure of information brought in by the non-Federal parties as well as information that is developed as a result of the research activities.

For example, a CRDC may develop a new type of software. Though the first part of this section would vest title in the government, current law requires the government to disclose the blueprint for that software. A company would be reluctant to help create the software if information the company brought in or information related to the creation of that software was then given out to its competitors.

However, information created as a result of the research activities under the amendment may be withheld from disclosure only up to 5 years. This gives the Secretary the flexibility and the discretion to decide how long the disclosure protection should be given.

Authorization

S. 1976 as originally introduced specified the level of funding for each activity authorized: basic research in hardware and software, the NREN, and education. The Administration supports a high-performance computing initiative, but objected to the specific funding levels assigned by the bill as this would restrict flexibility in an area of rapidly changing technologies.

Besides the elimination of specific references to kinds of technologies, the amendment addressed these concerns in two other ways. First, the authorization levels were combined into one general authorization section, giving the Administration flexibility to change funding levels regarding specific activities and technologies. Second, the amendment makes clear that the authorized funding levels are in addition to current levels of authority.

SECTION-BY-SECTION ANALYSIS

Section 1 establishes the short title, "The Department of Energy High-Performance Computing Act of 1990".

Section 2 contains the findings of Congress. High-performance computing has become an indispensable tool to our national security, economic competitiveness, productivity and our overall quality of life. Though the United States currently leads the world in high-performance computing, that lead is increasingly being challenged. In order to ensure that lead and obtain the greatest benefits from high-performance computing, the Federal Government must provide leadership in the research, development and application of high-performance computing technology through collaboration with industry, educational institutions and government laboratories.

Section 3 states that the purposes of the bill are to create a high-performance computing program within the Department of Energy, and to establish a Federal Interagency High-Performance Computing Task Force.

Section 4 contains definitions of terms used in the bill. The term "software creation" is defined for purposes of vesting title to software in secton nine.

Section 5 establishes a high-performance computing program within the Department of Energy. The Secretary is directed to establish a management plan to carry out program activities.

Section 6 establishes the program activities. The Secretary is to create a National Research and Education Network. The Secretary is to promote education and research in fields in and related to high-performance computing. The Secretary is to establish at least two Collaborative Consortia to undertake basic research and development of high-performance computing hardware, software and networks. Also, the Consortia are to promote the testing and uses of new types of high-performance computing, and to disseminate information on the availability of high-performance computing facilities.

Each Consortium is to be formed as collaborations between the federal laboratories, industry, universities, and others. Each Consortium is to be headed by a Department of Energy national laboratory that has experience in high-performance computing. Industrial participants are not to be reimbursed for costs associated with their own involvement.

Each consortium may be established as a Cooperative Research and Development Agreement as provided by title 15 U.S.C. section 3710a. The National Cooperative Research Act of 1984 also applies to research activities undertaken by the consortia.

Section 7 establishes a Federal interagency high-performance computing task force composed of the Secretary of Energy, the Secretary of Commerce, the Secretary of Defense, the Administrator of the National Aeronautics and Space Administration, and the Director of the National Science Foundation.

The task force is to develop a government-wide high performance computing strategy designed to: bring about the maximum efficient use of available Federal high-performance computing resources by Federal agencies; coordinate Federal agencies' high-performance computing roles, polices and activities; establish the level of federal funding needed to carry out the strategy for each agency; disseminate information to federal agencies, corporations, and educational institutions on the availability of federal high-performance computing facilities, and the means by which access can be obtained.

A private sector advisory panel to advise the Task Force would be composed of persons eminent in the field of high-performance computing from the educational establishment and the private sector.

Section 8 authorizes the Secretary, in accordance with applicable law, to cooperate with and enter into contracts with the privide sector and other Federal agencies to carry out the Act.

Section 9 establishes that title to inventions or creations (a defined term which essentially deals with software) vests in the United States in accordance with 42 U.S.C. section 5908. Trade secrets or commercial or financial information obained from non-federal parities is given protection from disclosure.

Section 10 authorizes $65,000,000 for fiscal year 1991, $100,000,000 for fiscal year 1992, $135,000,000 for fiscal year 1993,

170,000,000 for fiscal year 1994 and $205,000,000 for fiscal year 1995.

COST AND BUGETARY CONSIDERATIONS—

The following estimate of the cost of this measure has been provided by the Congressional Budget Office:

U.S. CONGRESS,
CONGRESSIONAL BUDGET OFFICE,
Washington, DC, July 5, 1990.

Hon. J. BENNETT JOHNSTON, Jr.,
Chairman, Committee on Energy and Natural Resources,
U.S. Senate, Washington, DC.

DEAR MR. CHAIRMAN: The Congressional Budget Office has prepared the attached cost estimate for S. 1976, the Department of Energy High-Performance Computing Act of 1990.

If you wish further details on this estimate, we will be pleased to provide them.

Sincerely,

ROBERT D. REISCHAUER,
Director.

1. Bill number: S. 1976.

2. Bill title: Department of Energy High-Performance Computing Act of 1990.

3. Bill status: As ordered reported by the Senate Committee on Energy and Natural Resources, June 27, 1990.

4. Bill purpose: The bill would authorize a High-performance Computing (HPC) Program within the Department of Energy (DOE) and would establish a Federal Interagency HPC Task Force.

S. 1976 would require DOE to develop and implement a plan to carry out HPC program activities, including coordination with other agencies for creating a national network of high-speed computers, which would be known as the National Research and Education Network (NREN). Under S. 1976, DOE also would establish two or more collaborative consortia to undertake basic research and development or HPC hardward, asssociated software, and prototype computer networks.

The bill would establish a Federal Interagency HPC Task Force to develop a government-wide HPC strategy, encourage efficient use of availabale HPC resources within the government, and coordinate federal agencies' HPC activities.

To find HPC activities by DOE and the Interagency Task Force, S. 1976 would authorize appropriations of $675 million over five years. The bill also would authorize DOE to charge fees for use of the proposed NREN system.

5. Estimated cost to the Federal Government:

[By fiscal year, in millions of dollars]

	1991	1992	1993	1994	1995
Authorization level	65	100	135	170	205
Estimated outlays	26	73	110	145	181

The costs of this bill fall within budget functions 050, 250, and 270.

Basis of estimate: This estimate assumes that the full amounts authorized would be appropriated for each fiscal year, and that spending will occur at historical rates for similar federal activities.

The bill would require DOE to establish the NREN as an operational system by the end of 1996. CBO expects that fees for use of the network would be phased in once the system is operating. Ultimately, such fees could provide a significant offset to the operating costs of the network, but we do not expect the government to collect any significant amount of receipts during the 1991–1995 period.

6. Estimated cost to State and local governments: None.

7. Estimate comparison: None.

8. Previous CBO estimate: On April 27, 1990, CBO provided a cost estimate for S. 1067, the High-Performance Computing Act of 1990, as ordered reported by the Senate Committee on Commerce, Science, and Transportation, on April 3, 1990. S. 1076 would authorize nearly $1 billion over five years for HPC activities by the National Science Foundation and the National aeronautics and Space Administration. S. 1067 would not authorize any funds for the DOE activities that S. 1976 would authorize.

9. Estimate prepared by: Perter Fontaine.

10. Estimate approved by James L. Blum, Assistant Director for Budget Analysis.

REGULATORY IMPACT EVALUATION

In compliance with paragraph 11(b) of Rule XXVI of the Standing Rules of the Senate, the Committee makes the following evaluation of the regulatory impact which would be incurred in carrying out S. 1976.

The bill is not a regulatory measure in the sense of imposing government-established standards or significant economic responsibilities on private individuals and businesses. The bill contains authorizations for a national research and education network, a research and development program within the Department of Energy, a federal interagency high-performance computing task force and directives to the Secretary of Energy with respect to the operation of these activities. Any involvement of private firms and individuals in these activities is voluntary.

No personal information would be collected in administering the program. Therefore, there would be no impact on personal privacy from the bill.

Little, if any, additional paperwork would result from the enactment of S. 1976.

EXECUTIVE COMMUNICATIONS

On December 6, 1989, the Committee on Energy and Natural Resources requested legislative reports from the Office of Science and Technology Policy, the Department of Energy, the National Science Foundation, the Department of Defense, the Department of Commerce, the National Aeronautics and Space Administration, and the Office of Management and Budget setting forth executive views on S. 1976.

The pertinent legislative report received by the Committee from the Department of Defense setting forth executive agency recommendations relating to S. 1976 is set forth below. No other legislative reports from the other agencies had been received at the time of filing this report. When the reports become available, the Chairman will request that they be printed in the Congressional Record for the advice of the Senate.

GENERAL COUNSEL OF THE
DEPARTMENT OF DEFENSE,
Washington, DC, May 23, 1990.

Hon. J. BENNETT JOHNSTON,
Chairman, Committee on Energy and Natural Resources,
U.S. Senate, Washington, DC.

DEAR MR. CHAIRMAN: This is in response to your request for the views of the Secretary of Defense on S. 1976, 101st Congress, a bill "To provide for continued United States leadership in high-performance computing."

S. 1976 would provide funds to the Department of Energy to engage in research and development in networking, software, high-performance computing systems, and basic research. Total funding to be authorized is $675M over five years.

The Department of Defense has reservations regarding this bill. In September 1989, the Office of Science and Technology Policy (OSTP) presented the Federal High Performance Computing Program, which was developed by the Federal Coordinating Council on Science, Engineering, and Technoplogy (FCCSET). The Department of Defense participated in the development of the OSTP program plan and supports it. There are, however, problems with the implementation approach embodied in S. 1976.

The Federal High Performance Computing Program presents a balanced plan involving four principal agencies, which are the National Science Foundation (NSF), the Department of Energy (DOE), the National Aeronautics and Space Administration (NASA), and the Defense Advanced Research Projects Agency (DARPA) of the Department of Defense. These agencies, with support from OSTP and the other agencies involved in the FCCSET process, have developed a coordination plan with assigned roles and responsibilities.

This balanced plan provides a means for effectively responding to the long-term high performance computing needs of the mission agencies, including DOE, DoD, and NASA, and for ensuring continued United States leadership in a technology area critical for national security.

As part of the plan development process, agencies agreed to take on leadership roles consistent with their strengths and capabilities. In particular, it has been agreed that the NSF is to take the lead in deployment of the National Research and Education Network, that DARPA is to take the lead in research for gigabit capacity networks, that NASA is to coordinate the software and algorithms efforts, and that DARPA is to take the lead in research in support of future high performance computing systems.

The Department of Defense has the following reservations regarding the bill:

1. The bill provides for the participation of one agency without regard to the contributions of the other agencies, whose participation is indicated above is essential in order to ensure success of the Program in meeting the long-term computing needs and in sustaining U.S. leadership.

2. The bill is inconsistent with lead agency assignments and budgets as developed through FCCSET coordination process and as agreed to by the participating agencies, including the Department of Energy. For example, the budget levels contained in the bill for the National Research and Education Network should be authorized primarily ot the NSF and DARPA.

The Office of Management and Budget advises that, from the standpoint of the Administration's program, there is no objection to the presentation of this report for the consideration of the Committee.

Sincerely,

TERRENCE O'DONNELL.

CHANGES IN EXISTING LAW

In compliance with paragraph 12 of Rule XXVI of the Standing Rules of the Senate, the Committee notes that no changes in existing law are made by the bill S. 1976, as reported.

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